

Kazuko M. EMURA (HASEGAWA)\*: A cytological study  
on the Eurasian species of the genus *Cimicifuga* (2)

江村(長谷川)一子\*: ユーラシア産サラシナショウマ属の  
細胞分類学的研究(2)

1. *C. japonica*

Specimens examined cytologically by the author.

Locality	Date	Collector
<i>var. japonica</i>		
Japan, Honshū:		
Mt. Bukō, Chichibu-gun, Saitama Pref.	Oct. 1966	Ohashi, H.
Mt. Takao, Minamitama-gun, Tōkyō Pref.	Oct. 1965	Emura (Hasegawa), K.
Ōizumi, Nerima-ku, Tōkyō Pref.	April 1966	Emura (Hasegawa), K.
Kamakura, Kanagawa Pref.	Sept. 1965	Emura (Hasegawa), K.
Shida Pass, Aikō-gun, Kanagawa Pref.	1964	Kanai, H.
Niino, Shimoina-gun, Nagano Pref.	May 1965	Kanai, H.
Mt. Ena, Nakatsukawa, Gifu Pref.	June 1965	Emura (Hasegawa), K.
Mt. Fujiwara, Inabe-gun, Mie Pref.	May 1964	Ihara, M. & Yamashita, T.
Mt. Fujiwara, Inabe-gun, Mie Pref.	1963	Hara, H.
<i>var. acutiloba</i>		
Mt. Ryōsen, Inukami-gun, Shiga Pref.	May 1966	Ihara, M. & Okubo, K.
Kitayama, Higashimuro-gun, Wakayama Pref.	1963	Hara, H.
Mt. Kongō, Minamikawachi-gun, Osaka Pref.	June 1967	Emura (Hasegawa), K.

*C. japonica* is distributed only in the limited part of Japan, the middle part of Honshu (the Pacific side and Kinki regions). The plants in the Kinki region have often more deeply incised leaflets and are distinguished

\* Department of Botany, Faculty of Science, University of Tokyo, Hongo, Tokyo. 東京大学理学部植物学教室。

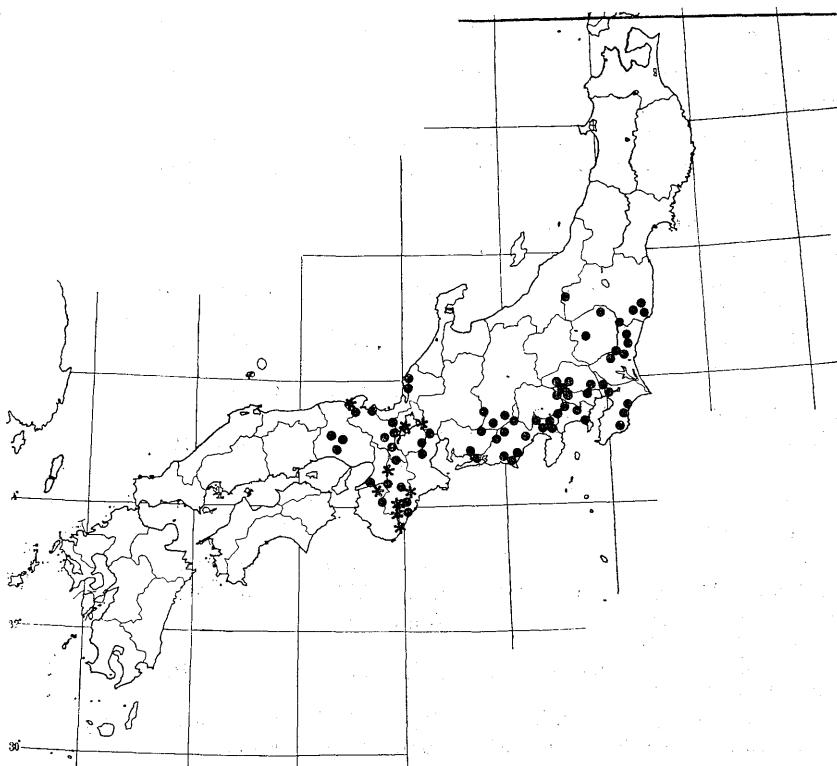


Fig. 6. Distribution of *C. japonica*. Circles: var. *japonica*. Asterisks: var. *acutiloba*.

by Hara, H. as var. *acutiloba* (Fig. 6). The habitats are shady grassland or woodside at alt. 10 m–1000 m. *C. japonica* and *C. japonica* var. *acutiloba* collected from 11 different localities above mentioned were proved to have  $2n=16$  chromosomes; and the karyotypes were similar to each other (Figs. 4 & 5). This species has been already studied cytologically by Kurita, M. 1957, and he reported that every pair of the V-shaped chromosomes have no satellite. In the present study, however, the author observed that a pair of the V-shaped chromosomes have small satellites in all the materials. The satellites were also observed in a pair of I-shaped chromosomes. This species including a variety is found to be cytologically very stable through all the

distribution areas.

## 2. *C. acerina*

Specimens examined cytologically

### var. *acerina*

Korea : Chechu Island, alt. 1900 m.	Oct. 1967	Lee, Y. N.
Japan : Mt. Unzen, Minamitakaki-gun, Nagasaki Pref.	Aug. 1965	Emura (Hasegawa), K.

### var. *intermedia*

#### Japan, Shikoku :

Mt. Ishizuchi, Kamiukena-gun, Ehime Pref.	Aug. 1965	Togashi, M.
Mt. Tsurugi, Oe-gun, Tokushima Pref. alt. 1600 m.	Aug. 1965	Okubo, K.
Mt. Tsurugi, Mima-gun, Tokushima Pref. alt. 1000 m.	Aug. 1965	Okubo, K.
Mt. Ishidate, Kami-gun, Kôchi Pref.	June 1966	Ohashi, H.

### var. *macrophylla*

#### Japan, Honshû :

Ôdate, Akita Pref.	Oct. 1965	Ihara, M.
Shidauchi, Morioka, Iwate Pref.	Oct. 1965	Ihara, M.
Inawashiro, Yama-gun, Fukushima Pref.	Aug. 1964	Emura (Hasegawa), K.
Kashi Spa, Nishishirakawa-gun, Fukushima Pref.	July 1966	Ohashi, H.
Jakko, Nikko, Tochigi Pref.	Sept. 1964	Ihara, M. & Kawano, S.
Tamozawa, Nikko, Tochigi Pref.	June 1965	Kanai, H.
Tozawa, Nikko, Tochigi Pref.	Sept. 1966	Kanai, H.
Utsunomiya, Tochigi Pref.	Aug. 1964	Emura (Hasegawa), K.
Mikuni Pass, Tone-gun, Gumma Pref.	Aug. 1964	Emura (Hasegawa), K.
Mt. Agatsuma, Azuma-gun, Gumma Pref.	May 1964	Hara, H.
Mt. Izugatake, Iruma-gun, Saitama Pref.	May 1964	Emura (Hasegawa), K.
Mt. Mitsumine, Chichibu-gun, Saitama Pref.	June 1965	Emura (Hasegawa), K.
Chichibu, Saitama Pref.	July 1965	Hara, H.
Ôyama, Naka-gun, Kanagawa Pref.	May 1966	Kanai, H.
Oshino, Minamitsuru-gun, Yamanashi Pref.	Oct. 1966	Togashi, M.
Mt. Kitadake, Nakakoma-gun, Yamanashi Pref.	Aug. 1967	Togashi, M.

### var. *peltata*

Kamiichi, Nakaniikawa-gun, Toyama Pref.	Nov. 1964	Shinno, K.
Ōshika, Shimoina-gun, Nagano Pref.	Aug. 1965	Yamazaki, T.
Takasu, Gunjō-gun, Gifu Pref.	May 1967	Emura (Hasegawa), K.
Mt. Ibuki, Sakata-gun, Shiga Pref.	1965	Ihara, M.

*C. acerina* is found in all the places in Japan except for Hokkaido, the southern part of Korea, and central China (Fig. 7). The shape of leaves is variable by the locality and it is divided by Hara, H. into four varieties in Japan and Korea. *C. acerina* var. *acerina* occur only in the northern part of Kyūshū in Japan and also in the southern part of Korea (Mt. Chii, Chechu Island, Kouche Island). The leaflets are thinner and smaller than

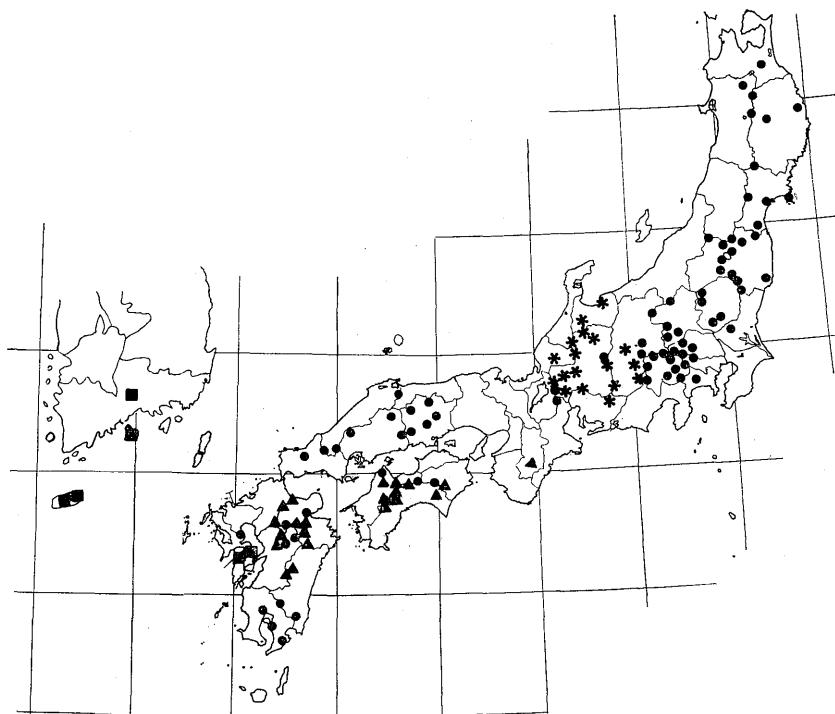


Fig. 7. Distribution of *C. acerina* (except China). Squares: var. *acerina*. Triangles: var. *intermedia*. Circles: var. *macrophylla*. Asterisks: var. *peltata*.

the other varieties and at the first glance, they can not be distinguished from *C. japonica*. *C. acerina* var. *macrophylla* is most common in Japan, and in the northern part of Honshû only var. *macrophylla* is found. The leaflets of var. *macrophylla* are often very large, and not so deeply incised on the margin. In the middle part of Honshu, a race with peltate leaves, var. *peltata*, occurs. The character of this peltate leaves seems to be variable; for instance, in many materials, all the leaflets of ternate leaves are peltate, but in a few materials, one leaflet of the ternate leaves is typical and the other two are peltate. The material with all peltate leaflets was transplanted from Mt. Ibuki to Tôkyô in early summer of 1964, however, in the spring of 1965, two of new leaflets were peltate and the other was typical. In some places, var. *macrophylla* are found mixed with var. *peltata*; for example, Mt. Ibuki (Gifu Pref.), Mt. Hijiri (Shizuoka Pref.), and Oshika-mura (Nagano Pref.). Some individuals from southern part of Japan (Shikoku, Kyushu, and Kii Peninsula) have leaflets more deeply incised than var. *macrophylla*. They are var. *intermedia*, which are also growing mixed with var. *macrophylla*.

In the present study, four varieties of *C. acerina* were studied based on many plants collected from the different localities as shown above. The chromosome numbers and karyotypes were found to be the same in all the materials, and this data agree with the report of Kurita. The chromosome number is  $2n=16$  and the karyotype is the same as that of *C. japonica* with two pairs of V-shaped and I-shaped chromosomes with satellites. This species is geographically variable in leaves, however, it is cytologically stable through all the varieties as in *C. japonica* (Figs. 4 & 5).

### 3. *C. simplex*

Specimens examined cytologically.

#### a. Plants with A-type chromosomes.

Japan, Hokkaidô and Honshû:

Nopporo, Sapporo, Hokkaidô	Aug. 1965	Ihara, M., Kawano, S. & Okubo, K.
Mt. Moiwa, Sapporo, Hokkaidô	Aug. 1965	Ihara, M., Kawano, S. & Okubo, K.
Mt. Soranuma, Sapporo-gun, Hokkaidô	Sept. 1964	Haga, M.
Maruyama, Sapporo, Hokkaidô	Sept. 1965	Matsunaga, K. & Emura (Hasegawa), K.

Mt. Hakodate, Hakodate, Hokkaidô	Aug.	1965	Ihara, M., Kawano, S. & Okubo, K.
Aizuwakamatsu, Fukushima Pref.	Oct.	1965	Ihara, M.
Rokujûrigoe, Minamiaizu-gun, Fukushima Pref.	Aug.	1964	Emura (Hasegawa), K.
Nanairi, Minamiaizu-gun, Fukushima Pref.	Aug.	1964	Emura (Hasegawa), K.
Kuruma Pass, Kawanuma-gun, Fukushima Pref.	Aug.	1964	Emura (Hasegawa), K.
Mt. Zaô, Iwafune-gun, Niigata Pref.	July	1965	Yamazaki, T.
Torii Pass, Higashikambara-gun, Niigata Pref.	Aug.	1964	Emura (Hasegawa), K.
Shimizu, Minamiuonuma-gun, Niigata Pref.	Aug.	1964	Emura (Hasegawa), K.
Mikuni Pass, Tone-gun, Gunma Pref.	Aug.	1964	Emura (Hasegawa), K.
Mt. Tanigawa, Tone-gun, Gunma Pref.	July	1966	Emura (Hasegawa), K.

## b. Plants with B-type chromosomes.

Japan, Honshû and Shikoku:

Hikawa, Nishitama-gun, Tôkyô Pref.	Oct.	1965	Emura (Hasegawa), K.
Mt. Takao, Minamitama-gun, Tôkyô Pref.	Sept.	1965	Emura (Hasegawa), K.
Nippara, Nishitama-gun, Tôkyô Pref.	Sept.	1966	Kanai, H.
Mt. Tanzawa, Aikô-gun, Kanagawa Pref.	Sept.	1965	Uchida, Y.
Kamakura, Kanagawa Pref.	Sept.	1965	Emura (Hasegawa), K.
Yugashima, Idsu Peninsula, Shizuoka Pref.	Oct.	1965	Emura (Hasegawa), K.
Yoichizaka, Idzu Peninsula, Shizuoka Pref.	Oct.	1965	Emura (Hasegawa), K.
Mt. Tôgasa, Idzu Peninsula, Shizuoka Pref.	Oct.	1965	Emura (Hasegawa), K.
Kijima, Ibara-gun, Shizuoka Pref.	Apr.	1966	Emura (Hasegawa), K.
Mt. Hiei, Ôtsu, Shiga Pref.	Aug.	1965	Emura (Hasegawa), K.
Mt. Ishidate, Kami-gun, Kôchi Pref.	June	1966	Ohashi, H.

## c. Plants with C-type chromosomes.

Japan, Honshû and Shikoku:

Ginzandaira, Kitauonuma-gun, Niigata Pref.	Aug.	1964	Emura (Hasegawa), K.
Tadamisawa, Minamiaizu-gun, Fukushima Pref.	Aug.	1964	Emura (Hasegawa), K.

Kiriake, Shimotakai-gun, Nagano Pref.	Aug.	1964	Emura (Hasegawa), K.
Uenohara, Shimotakai-gun, Nagano Pref.	Aug.	1964	Emura (Hasegawa), K.
Hinokimatadeai, Shimotakai-gun, Nagano Pref.	Aug.	1964	Emura (Hasegawa), K.
Fujimi, Suwa-gun, Nagano Pref.	June	1965	Emura (Hasegawa), K.
Mt. Nyūgasa, Suwa-gun, Nagano Pref.	June	1965	Emura (Hasegawa), K.
Fukiage, Kamiina-gun, Nagano Pref.	Aug.	1965	Kanai, H.
Jizō Pass, Shimoina-gun, Nagano Pref.	Aug.	1965	Kanai, H.
Karuizawa, Kitasaku-gun, Nagano Pref.	Sept.	1966	Emura (Hasegawa), K.
Tokusa, Abe-gun, Shizuoka Pref.	Aug.	1967	Wada, M.
Tsubamezawa, Abe-gun, Shizuoka Pref.	Aug.	1967	Wada, M.
Marunuma Spa, Tone-gun, Gumma Pref.	Sept.	1965	Kanai, H.
Usui Pass, Usui-gun, Gumma Pref.	May	1965	Okubo, K.
Nikko, Tochigi Pref.	Sept.	1965	Kanai, H.
Jakko, Nikko, Tochigi Pref.	Sept.	1965	Ihara, M., Kawano, S. & Okubo, K.
Mt. Shiraiwa, Chichibu-gun, Saitama Pref.	June	1965	Emura (Hasegawa), K.
Tamba, Funai-gun, Kyōto Pref.	Oct.	1965	Tamura, M.
Mt. Tsurugi, Oe-gun, Tokushima Pref.	Aug.	1965	Okubo, K.
Mt. Ishizuchi, Kamiukena-gun, Ehime Pref.	Sept.	1965	Togashi, M.

*C. simplex* is widely spread in Asia throughout Japan, Korea, Manchuria, Mongolia, the southeastern Siberia, Saghalien, Kurile Islands (the southern four islands), and the southern Kamchatca (Fig. 8). *C. simplex* is very variable in the external morphology. Especially the shape and the size of leaves and the length of the inflorescence are apparently variable at the first glance. In Hokkaido, Tōhoku and the middle alpine regions, the plants are tall up to 2 m, the inflorescences are long as 30 cm, and the leaflets are as large as 7–10 cm in length, and are ovate, and incised on the margin. On the other hand, in the middle lower part of Honshu, they are rather slender, and especially the leaflets are smaller, 1–3 cm in length, and also ovate, incised on the margin. In the other place, the leaflets are not so

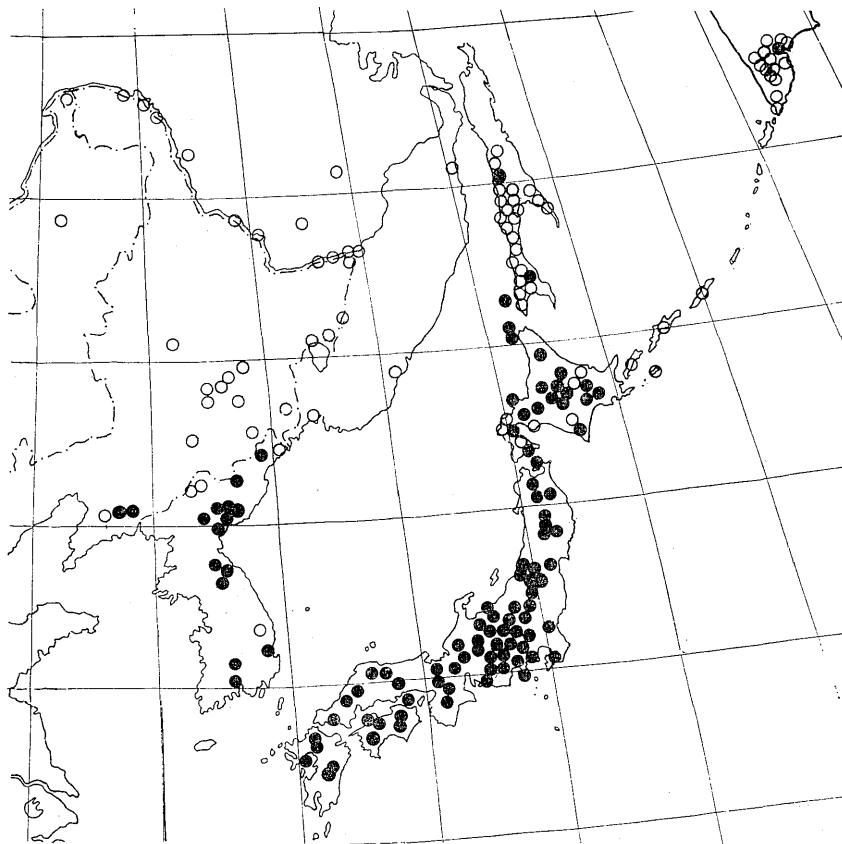


Fig. 8. Distribution of *C. simplex*. Solid circles: herbarium specimens. Open circles: from references.

ovate but lanceolate. Some specimens of Korea and Manchuria have not tri-ternate leaves but pinnate-ternate leaves. *C. simplex* was divided into seven varieties by Nakai, T. 1916, based on the variations of external morphology. The type specimens of these seven varieties can be easily distinguished, but in the fields or in the herbarium specimens, it is so difficult to distinguish them clearly. In the present study, about two hundreds sheets of the dried specimens and forty two living materials in Japan were observed, and it was remarked that the hairs on the upper leaflet-surface

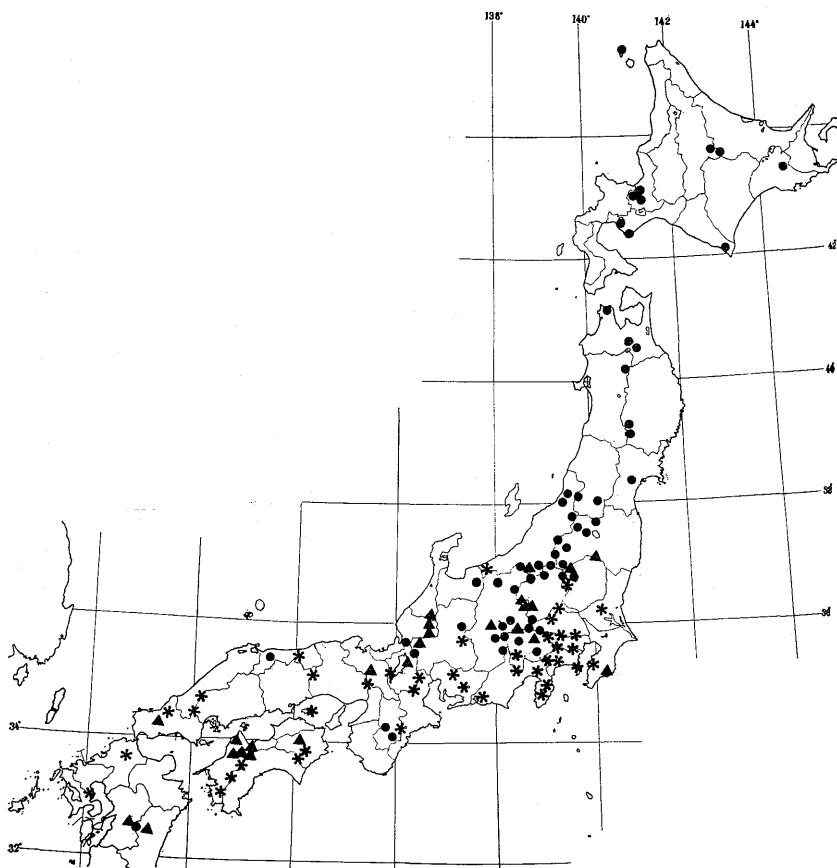


Fig. 9. Distribution of *C. simplex* in Japan showing the variations of hairs on the upper leaflet's surface. Circles: glabrous type. Asterisks: pubescent type. Triangles: sparsely pubescent type.

are locally variable. In some plants, all the mature leaflets are glabrous on the upper surface, but in the other plants, densely pubescent on the basal part of midrib and lateral veins. Those two types are not always distinct, and the leaflets of some plants are sparsely pubescent on the midrib and lateral veins. *C. simplex* in Japan was divided into three types as above mentioned by the character of the upper leaflet's surface, and the distribution map was drawn (Fig. 9). It shows that the glabrous type is dispersed

all over Hokkaido and Tohoku regions, the alpine regions of middle Honshu, and rarely in the southern parts: while the densely pubescent type in the lower part of Kantō region (Tōkyō and Kanagawa Pref.), Idzu Peninsula, Kinki, Chūgoku region and Kyūshū; the sparsely pubescent type appears in the subalpine regions excepting Hokkaidō and Tōhoku regions.

Cytologically, the chromosome analysis of *C. simplex* var. *ramosa* Nakai and var. *yedoensis* Nakai was precisely made by Kurita, M. 1957, and now, forty-five materials collected from different places were studied. The chro-

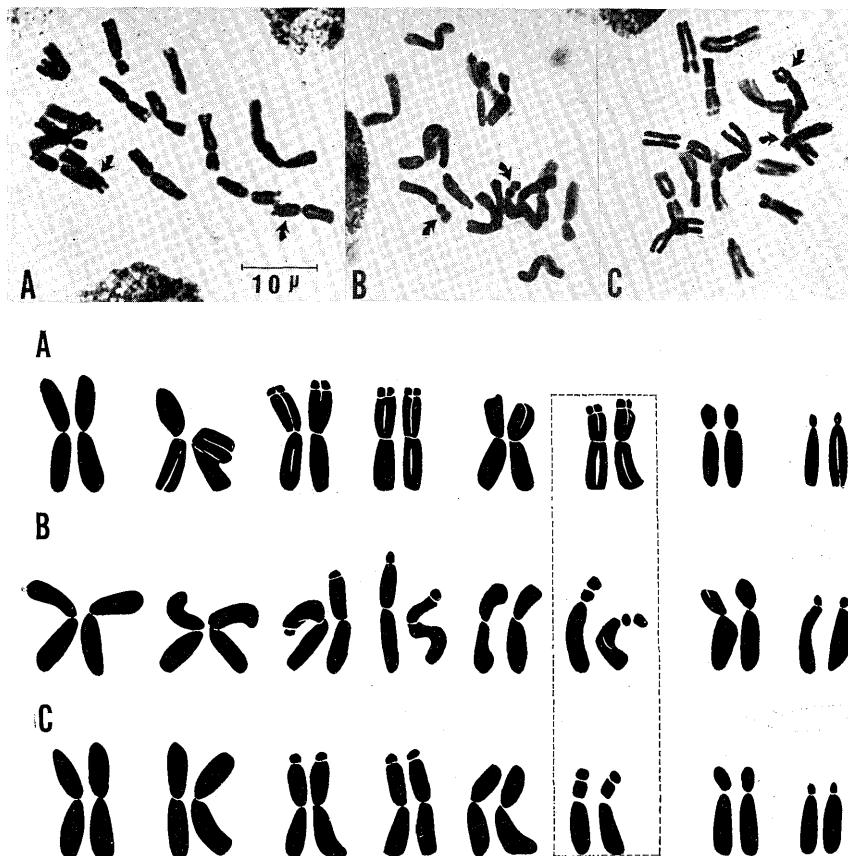


Fig. 10. Somatic chromosomes of *C. simplex* in Japan showing the karyotype variation.  
A. A-type, B. B-type, C. C-type.

mosome numbers was all  $2n=16$ , and the karyotypes were slightly but distinctly divided into three types (Fig. 10). The author provisionally named the first type as A-type, the second one B-type, and the third one C-type. In these types, it was recognized that a pair of submetacentric chromosomes with secondary constriction was variable. In the A-type, the arm between two constrictions is the longest of all the three types, but in the B-type it

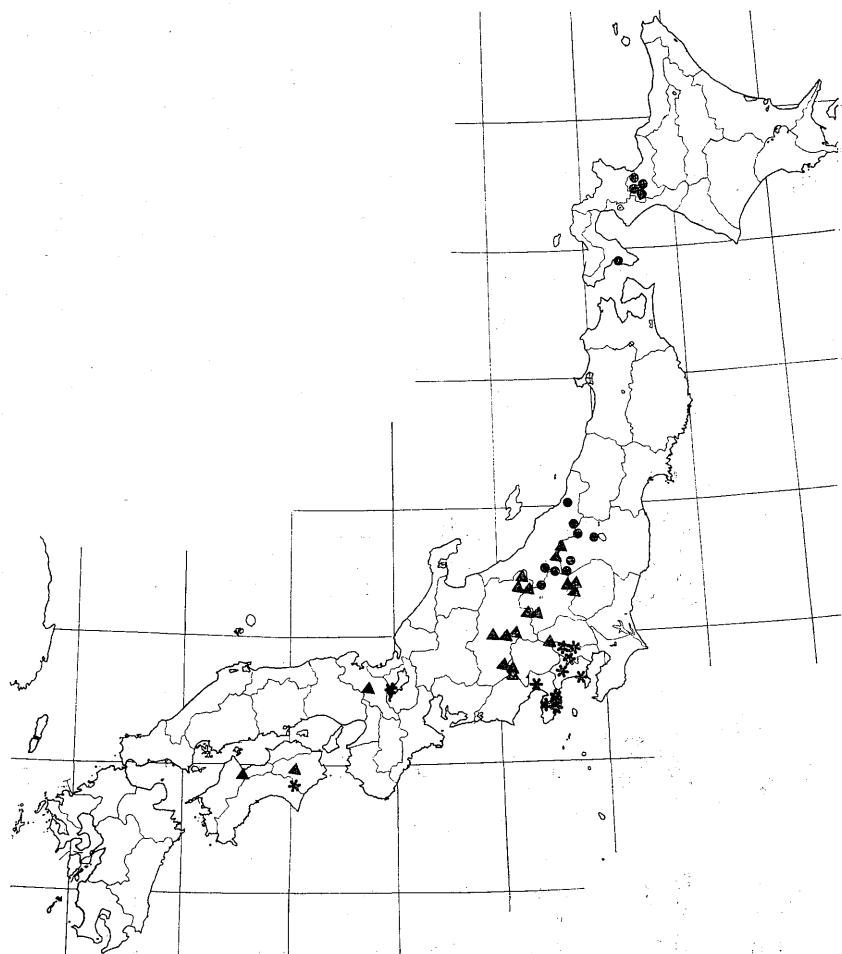


Fig. 11. Distribution of *C. simplex* in Japan showing the variations of chromosomes. Circles: A-type. Asterisks: B-type. Triangles: C-type.

is the shortest, and the C-type is intermediate in length. The distribution map (Fig. 11) shows the distribution of the three types distinguished by the karyotypes.

By the present study, the collections of the living plants were so insufficient that the precise correlation between the karyotype and the external morphology could not be well found, however, the rough tendency of the correlation was observed. The plants with A-type chromosomes are all glabrous on the upper leaflet's surface, those with B-type chromosomes are all densely pubescent, and the plants with C-type chromosomes are sparsely pubescent or glabrous. Considering the other morphological characters and the distributions, the plants with A-type chromosomes (14 materials) are very tall as 1.5–2 m, the leaflets are also as large as 5–10 cm long, the inflorescence long up to 20–30 cm, and they are distributed in the northern part of Japan, and the southern limit is the Fukushima Prefecture. In the more southern part, no A-type plants are found even if they are glabrous on the upper leaflet's surface, and the plants are large. On the other hand, those with B-type chromosomes (11 materials) are smaller as a whole, than the former, the leaflet size as small as 2–3 cm long; they are typical in the middle part of Tôkyô, the coastal regions of Kanagawa Prefecture, and Izu Peninsula; there occur the plants also with typical B-type chromosomes and densely pubescent on the upper leaflet's surface in Tamba and Mt. Hiei in Kyôto, or Mt. Turugi in Shikoku, but the leaflets are more lanceolate and longer as 4–7 cm than those in Tôkyô or Kanagawa regions. The plants with C-type chromosomes (20 materials) are distributed in the middle part of Japan and Shikoku, and the habitats are not mixed with the plants with A or B-type chromosomes but the external morphology of these plants are so various. According to the classification of Nakai, the hairs on the ovary and the length of the stipe are used as the important markers, however, all the ovaries were pubescent, and it was unable to clearly distinguish them by the density in the present study, the length of the stipe as well.

Now, it was found that in all parts of Japan from south to north, *C. simplex* is varied in its external morphology and karyotypes, and that especially its two types were very different from each other. One type occurs in the northern part of Japan (Hokkaidô and Tohoku), and the plants are very large, and the upper leaflet's surface is glabrous. Another type occurs

in the lower middle part of Japan (around Tôkyo and Kanagawa Prefecture), and the plants are smaller as a whole and densely pubescent on the basal part of midrib and lateral veins. Many kinds of intermediate plants are also present, and the many intermediate characters are considered to be unstable, but their habitats are limited to the middle or southern subalpine regions.

#### 4. *C. dahurica*

Specimens examined cytologically

Korea: Kwangnung, Kyonggi-do. 1965 Lee, T.B.

Korea: Kwangnung, Kyonggi-do. Oct. 1967 Lee, Y.N.

*C. dahurica* occurs all over Korea, Manchuria and Dahuria (Fig. 12), but not in Japan. The chromosomes of two male plants from Korea were observed to be  $2n=16$ , and secondary constrictions were found in a pair of

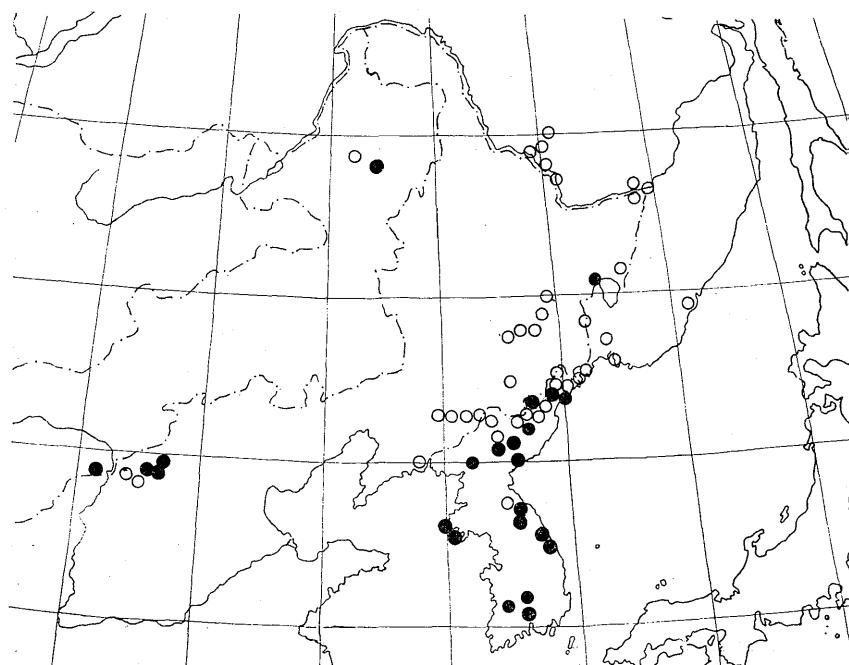


Fig. 12. Distribution of *C. dahurica*. Solid circles: herbarium specimens. Open circles: from references.

V-shaped chromosomes and a pair of J-shaped chromosomes. The present observation almost agrees with the reports of Langlet 1932. (Fig. 4 & 5).

### 5. *C. heracleifolia*

*C. heracleifolia* has limited distribution in Korea and southern Manchuria. (Fig. 13) A plant from Korea (Kwangnung, Kyonggi-do; collected by Lee, Y. N. 1967) was transplanted in Japan and the chromosomes were first observed to be  $2n=16$ . The karyotypes are almost similar to those of *C. dahurica* with secondary constrictions in two pairs of V-shaped and J-shaped chromosomes (Fig. 4 & 5).

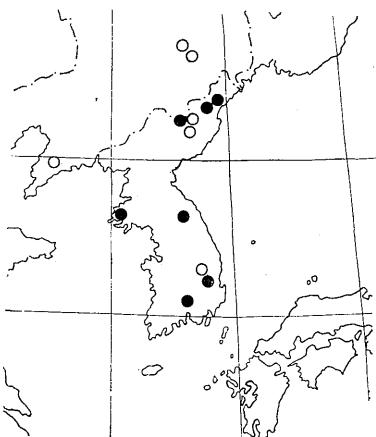


Fig. 13. Distribution of *C. heracleifolia*.  
Solid circles: hebarium specimens.  
Open circles: from references.

### Summary

All the Eurasian species of *Cimicifuga* were cytologically studied. The floral structures of follicles, seeds and petals were comparatively studied and the phyletic relations between the species were considered. Cytologically, the chromosome numbers of all the species are  $2n=16$  (excepting for Himalayan *C. foetida*), and the karyotypes are slightly different each other. Especially in Japan, the karyotypes of *C. simplex* are differentiated regionally and three types with slightly different karyotypes were observed. The genus *Cimicifuga* in Eurasia is considered to be cytologically stable through all species especially in the Japanese species excepting *C. foetida*.

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*Cimicifuga* 属は北米に 5 種、ユーラシアには 6 種知られているが、ユーラシア産全種について外部形態的に、また地理学的及び細胞学的に検討することによって種間の関係及び種内の変異を明らかにしようとした。まず、花の形態について、アメリカ産のものも考慮にいれて再検討した。特に袋果と種子には 2 型があり、ユーラシア

では *C. acerina* と *C. japonica* の袋果は花柱が短く真すぐりのび、この袋果に出来る種子は常にミカンの袋状の形で厚みがあり表面に翼は無い。これに対し、他のすべての種、即ち *C. foetida*, *C. simplex*, *C. dahurica* 及び *C. heracleifolia* の袋果は花柱が細長くて曲っており、この袋果に出来る種子は常にやや平らな橢円形で多くの薄い翼がおおっている。アメリカ産の5種にも同様な2型が見られた。そこでこの2型の種子の成長の過程を追って比較すると、初期のうちは両方の種子とも前者の種子の「ひな型」であり、前者はそのままの形で成長し、後者はやがて翼が出て平らに変ってゆくことが分った(Fig. 1)。以上の事実及びその他の特徴を考えあわせると、後者の種子と袋果を持つ群(Sect. *Cimicifuga*)は前者の種子と袋果を持つ群(Sect. *Pityrosperma*)から分化したものと思われる。また花弁の形(Fig. 3)は、特にSect. *Cimicifuga*に属する種では非常に変異が多いが、中でも *C. dahurica* の花弁は2裂片の先が薬に似た袋状であり、雌雄異株のものが多いことからも特殊化した種と思われる。

細胞学的には前報でヒマラヤの *C. foetida* に4倍体のあることを報告したが、それ以外は今回しらべた限りすべて2倍体( $2n=16$ )であった。ことに日本産の3種(*C. acerina*, *C. japonica*, *C. simplex*)については多くの場所から、形態的に色々変異のあるものを集めてしらべたが倍数体は見られなかった。核型については *C. acerina* と *C. japonica* はすべての変種を含めて日本中同じ核型を示すが、*C. simplex* では1組の染色体の核型にわずかではあるが3とおりの変異のあることが観察され、便宜上、ABCの3型に分けた。そのうちA型のものは日本の北部(福島県以北)にのみ分布し、全体大型で、葉の表面は全く無毛である。B型のものは関東以西の温暖な低地に多く分布し、全体に小型で葉の表面にはかなり密に毛がはえている。C型は核型の上ではA型とB型の中間型を示し、分布はやはり関東以西であるが、B型の生えているところよりは高度の高い山地に見られた。C型のものは外部形態的には変異が多く、B型やA型に見られる様なはっきりした特徴は見られない。この他、韓国産の *C. dahurica* と *C. heracleifolia* についても初めて観察したが、いずれも2倍体で、両者の核型はよく似ている。ユーラシア産の *Cimicifuga* 属は、4倍体の存在する *C. foetida* を除いては、多少の核型の変異はあっても、細胞学的にかなり安定していると思われる。

#### ○*Ludwigia* 属の外来品(浅井康宏) Yasuhiro ASAI: On *Ludwigia linearis* Walter newly introduced to Japan as an alien weed.

近年、日本へ侵入する所謂外来雑草の種類は、実に夥しいものがあり、枚挙にいとまがない程である。その侵入状態は、現在の交通、その他の事情から北アメリカを原産とするものが大部分を占めているが、しかしヨーロッパその他の原産で、北アメリカ